



For Supervisor's use only

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90254



NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA



National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

Level 2 Physics, 2006

90254 Demonstrate understanding of waves

Credits: Four

2.00 pm Monday 20 November 2006

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should answer ALL the questions in this booklet.

For all numerical answers, full working must be shown. The answer should be given with an SI unit.

For all 'describe' or 'explain' questions, the answer should be in complete sentences.

Formulae you may find useful are given on page 2.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–9 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

For Assessor's use only		Achievement Criteria	
Achievement		Achievement with Merit	Achievement with Excellence
Identify or describe aspects of phenomena, concepts or principles.	<input type="checkbox"/>	Give descriptions or explanations in terms of phenomena, concepts, principles and /or relationships.	<input type="checkbox"/>
Solve straightforward problems.	<input type="checkbox"/>	Solve problems.	<input type="checkbox"/>
Overall Level of Performance (all criteria within a column are met)			<input type="checkbox"/>

You are advised to spend 40 minutes answering the questions in this booklet.

You may find the following formulae useful.

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i} \quad \text{or} \quad s_i s_o = f^2$$

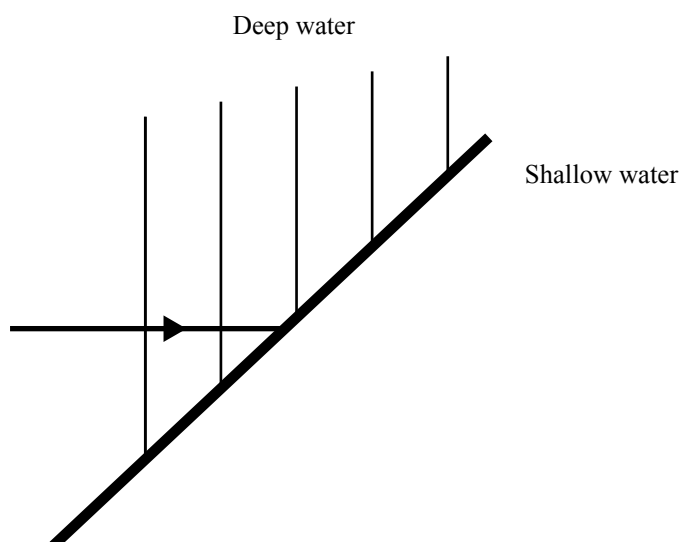
$$m = \frac{d_i}{d_o} = \frac{h_i}{h_o} \quad \text{or} \quad m = \frac{f}{s_o} = \frac{s_i}{f}$$

$$n_1 \sin \theta_1 = n_2 \sin \theta_2 \quad \frac{n_1}{n_2} = \frac{v_2}{v_1} = \frac{\lambda_2}{\lambda_1}$$

$$v = f\lambda \quad f = \frac{1}{T} \quad v = \frac{d}{t}$$

QUESTION ONE: WAVES

Roy and Sally spent time on a beach watching the incoming waves. The diagram below shows wavefronts as they approach shallow water. The waves travel slower in shallow water.



- (a) On the **above** diagram, draw an arrow showing the **wave direction** and the **refracted wavefronts** in the shallow region.
- (b) Clearly **explain** why the waves behave as you have drawn them in the diagram above.

- (c) **State** what happens to the **frequency** and **wavelength** of the waves as they pass from deep to shallow water.

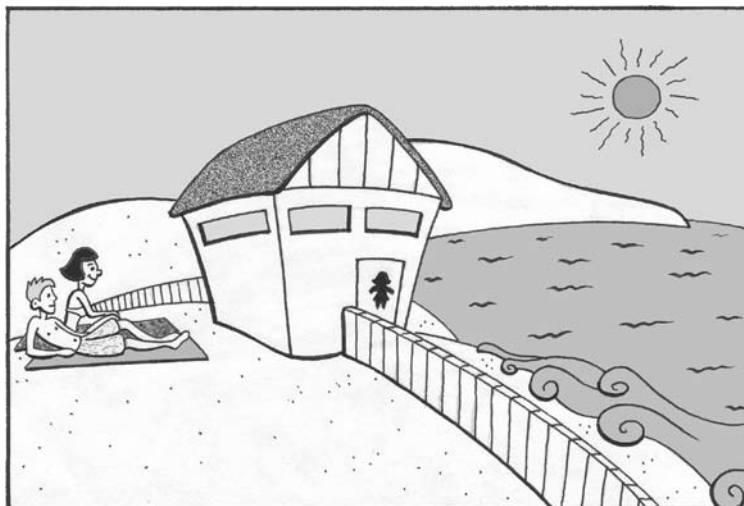
Frequency _____

Wavelength _____

- (d) Roy counted 8 complete waves passing a fixed point in 20 seconds. **Calculate** the frequency of the waves.

- (e) **State** two possible units for frequency.

- (f) The speed of the waves in shallow water is 2.8 m s^{-1} . **Calculate** the wavelength of these waves.



- (g) Give a physics reason why Roy and Sally could **hear the sound** of the waves when they were sitting behind a building at the beach, even though they could **not** see the waves.

(h) **State TWO** important physical differences between **sound** waves and **light** waves.

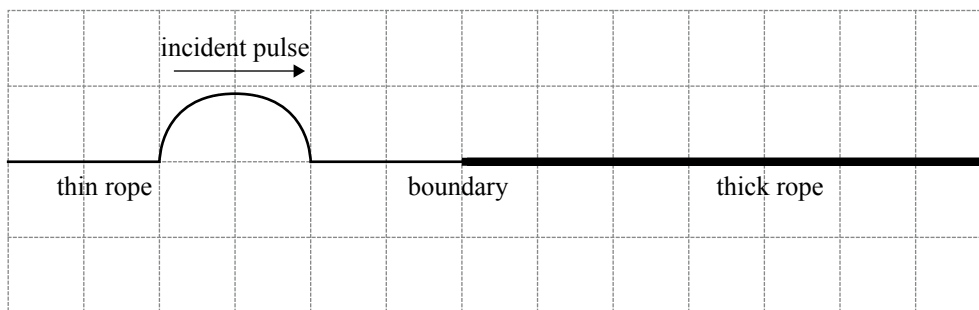
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- (1) _____

- (2) _____

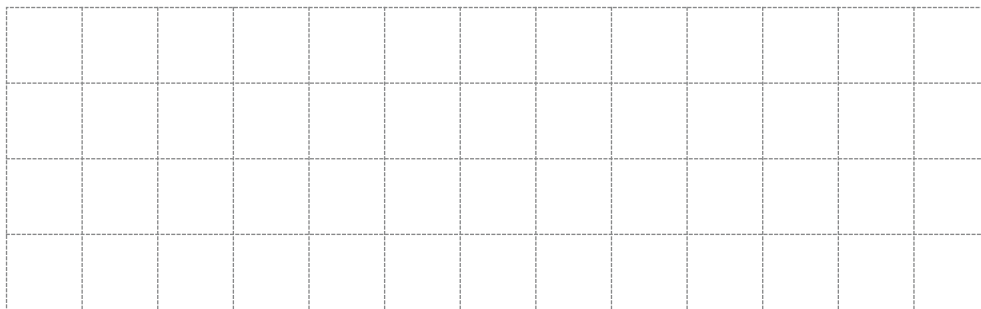
Roy and Sally took skipping ropes to the beach. One rope was thicker than the other. They tied the two ropes together. Roy held the thin rope and gave it a flick so that a pulse travelled along the thin rope towards the thick rope as shown in Box One below.

Box One



(i) **Draw a diagram** in Box Two below, to show the **reflected** and **refracted** pulses after the pulse hits the boundary. (The pulse travels faster in the thin rope.)

Box Two

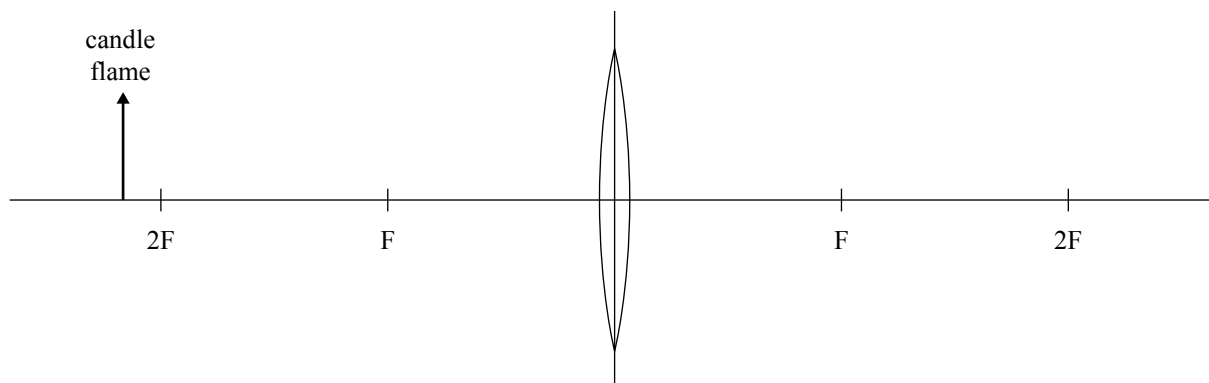


QUESTION TWO: LIGHT

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Sally uses a **convex lens** to project the image of a candle flame onto a screen.

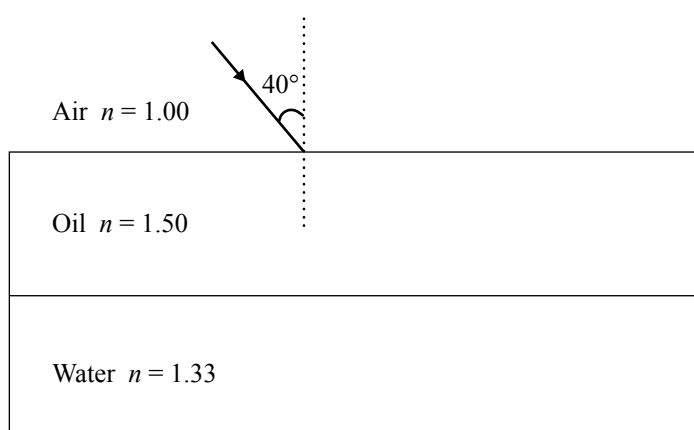
- (a) **Draw TWO** appropriate rays on the diagram below to show where the clear image of the candle flame would be formed. Draw the image in the correct position.



- (b) The candle flame is 2.0 cm high and 13.0 cm away from the lens.
The focal length of the lens is 6.0 cm.

Calculate the height of the candle flame's image.

Roy and Sally noticed a puddle of water with oil floating on top. The diagram below shows a ray of light travelling from air as it meets the air-oil interface.



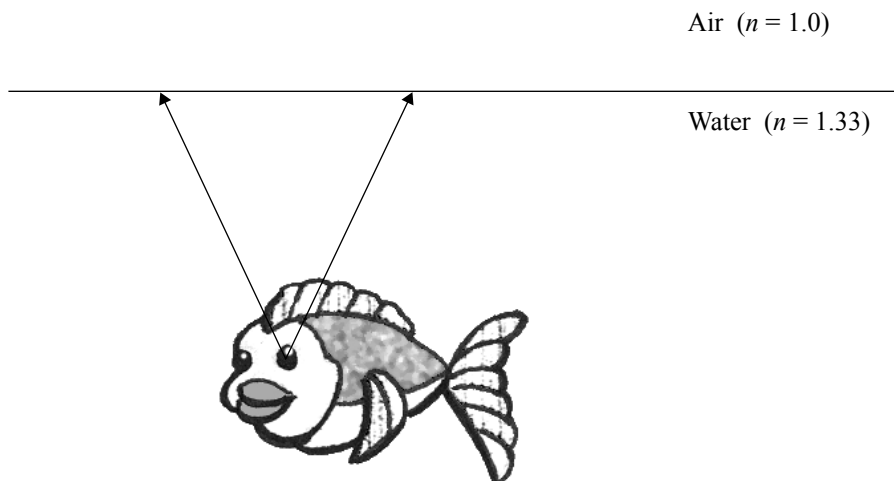
- (c) Complete the path of the ray of light in the above diagram to show what happens to the ray as it enters the oil, and then the water.

- (d) The ray of light meets the air-oil interface at an angle of incidence of 40° , as shown on the previous page. Calculate the angle of refraction when the ray goes into the **water**.

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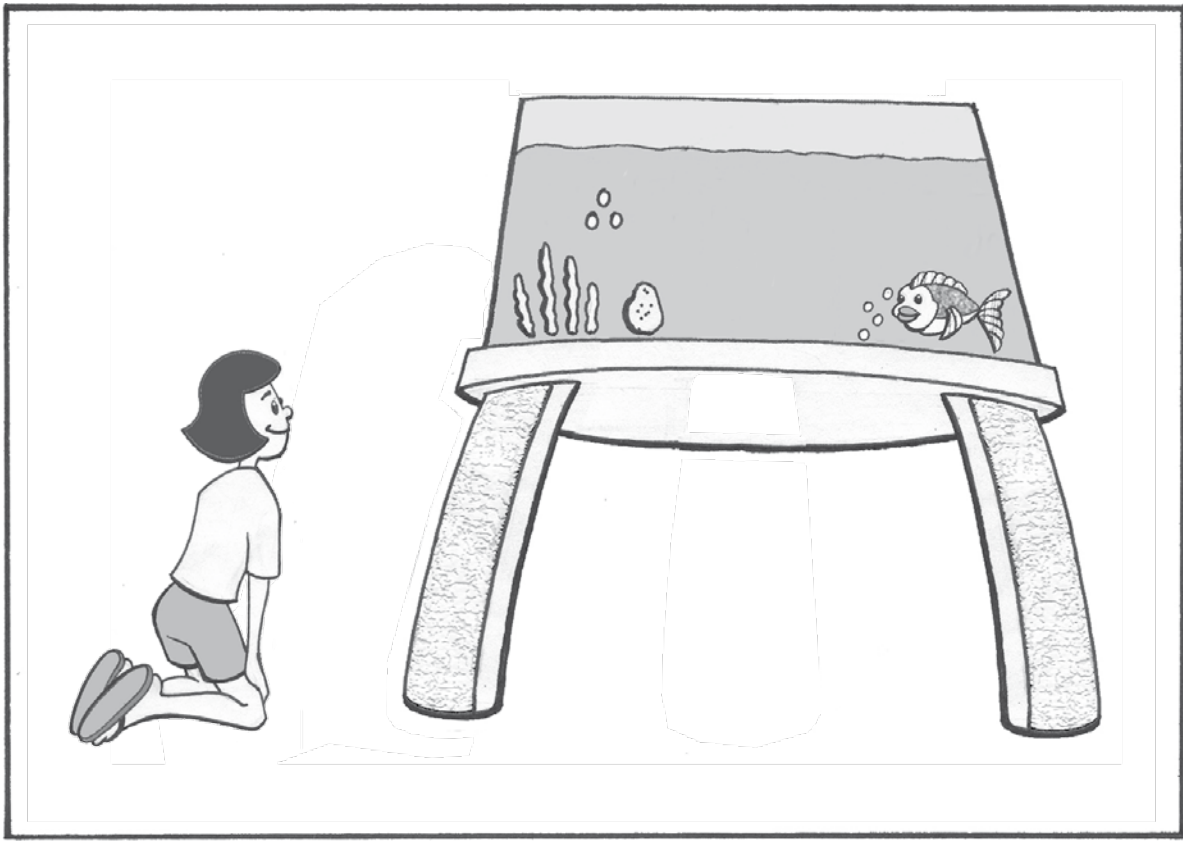
Roy and Sally visited a pet shop to buy a fish in a tank.

- (e) On the diagram below **draw appropriate rays** to locate the **image** of the fish if Roy was looking at it from above.



Sally knelt down to take a closer look at the fish. While looking **up** at the surface of the water in the fish tank, she noticed that the surface of the water looked like a mirror and she could see the reflection of the fish in it.

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- (f) **Explain** concisely, using physics principles, the conditions that are required for the rays of light from the fish to **reflect** off the water/air boundary (interface).

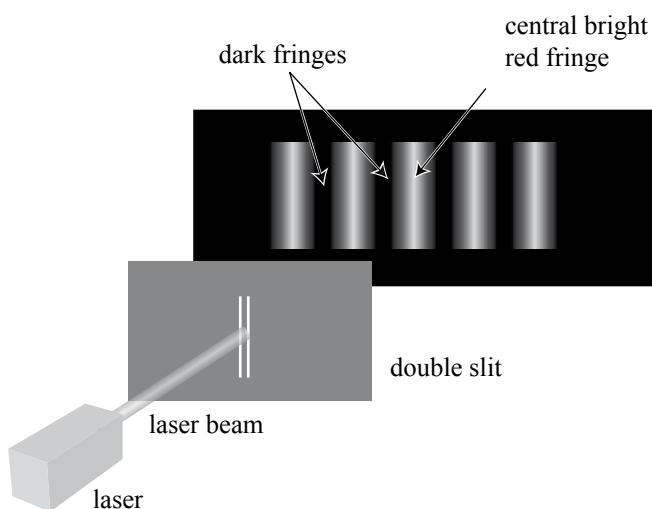
- (g) Calculate the critical angle of the water/air interface. Express your answer to the correct number of significant figures.

The refractive index of water is 1.33

The refractive index of air is 1.0

Roy and Sally later shone a red laser beam through two narrow slits. They saw a pattern formed on the wall as shown in the diagram below.

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(h) **State** a name given to the bright fringe.

(i) **Explain** clearly why there are **dark** fringes on either side of the central bright fringe on the wall.

[illegible]

